# How Brazil is Addressing the Challenges Associated with Incorporating Renewables into the Energy Supply System

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Brazilian energy policy aims at a rational use of energy sources, environmental awareness and implementation of energy conservation strategies. Despite the fact that the Brazilian electricity matrix is predominantly renewable, Brazil signed the Paris Agreement in 2015, committing itself to reach the target of 33% of renewable energy in the electricity matrix, excluding the hydroelectric source, by 2030.

The Brazilian electric energy sources expansion model has been based on large generating parks of hydroelectric and thermoelectric origin. Alternative sources - wind, solar and biomass - have been introduced in the National Electric System in a centralized approach, requiring the construction of long power transmission networks for generation to reach distant centers of consumption.

The reduction of pollutant gases is a recurrent theme and the investment in alternative sources for the generation of energy have reached a record in annual growth. The electric sector is strategic, but as world economies are facing continued change, the world's electric sector has undergone a vast process of organizational restructuring. In the current model, electrical systems are typically divided into segments such as generation, transmission, distribution and commercialization (LEÃO, 2012).

The increase in energy consumption is due to the increase in generation, which is limited by the capacity of its system, so the excess of demand served by the capacity of the system must be followed by the construction of new generation units, which may increase transportation and distribution of its commercialized energy (Barbosa e Azevedo, 2014).

The increase in the demand for electricity generates the need to optimize the use of the available resources, since, in a world in which losses become less and less acceptable, there must be an effort employed by energy companies in the search for improvement of their systems, as well as an effort by Society to obtain adequate planning of its restructuring and networks.

The availability of an efficient connective electrical infrastructure in Brazil depends on the combination of three factors: (i) competitiveness, (ii) security of supply; and (iii) economic and environmental sustainability. In this sense, the insertion of new sources must aim at safe and expanded generation, with a consequent reduction of tariffs for the final consumer.

Despite the preponderance of alternative sources, the diversification of the electric matrix is important because it promotes environmental sustainability, reinforces the security of supply in the country, and is in compliance with national energy policy guidelines.

From the environmental point of view, they contribute decisively to Brazil's compliance with the agreed targets under the climate agreement., the aforementioned target of 33% of renewable energy (excluding hydraulics) in the electricity matrix by 2030.

The Brazilian generation electricity matrix is composed of the following renewable sources (excluding hydraulics): bagasse, 5.6%; Wind, 3.5%; Solar, 0.06%; other renewables, 2.4%, totaling 11.5%. In 2024, it's expected to be biomass, 11.8%; Wind, 8.0%; and solar, 0.6%, totaling 20.4% of the electric generation (MME, 2016).

Development in public policy was driven by Law n. º 9.427, of 1996, since it granted discounts of at least 50% in the tariffs to users of transmission systems (TUST) and distribution (TUSD) for hydropower plants in a small size, known as PCH and producing energy between 1MW and 30MW.

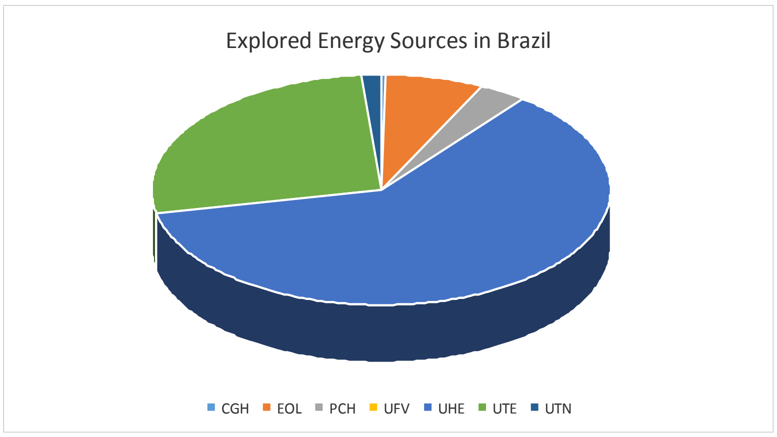


*Figure 1 – Explored Energy Source*
Source: BEN 2016

CGH - Central hydroelectric power plant with reduced capacity
EOL - Eollectric generating plant
PCH - Small hydroelectric plants
UFV - Solar photovoltaic plant
UTE - Thermoelectric plant
UTN - Thermonuclear plant

This measure allowed the reduction of costs when accessing the network and, consequently the cost of this energy. In 1997, Law n.º 9,478 promoted the inclusion of the use of alternative sources of energy among the goals of national energy policy. The discount on TUSD and TUST has been progressively extended to other non-hydro renewable sources, such as wind, biomass, qualified cogeneration. Currently, the discount on these services is 100% for almost all sources. In the case of biomass composed of solid waste and / or landfill biogas or biodigestors of vegetable or animal waste, as well as sludge from sewage treatment plants, the discount is 50%. In the first ten years, a discount of 80% will apply to solar energy in commercial operation until December 31, 2017, and after this date, the discount will be reduced to 50%.

In 2003, consumers were granted the TUST and TUSD rebates, and in 2015, Law n.º 13.203,of 2015, granted this discount to auto producers, limiting the injected power from 30,000 kW to 300,000 kW, and Law nº 13.299, of 2016, extended the benefit for biomass and PCHs with injected power between 30,000 and 50,000 kW (with a discount limited to 30,000 kW), in order to encourage repowering (replacement of part or components of a material for the purpose of improving performance by altering the characteristics of the design). Another important aspect to highlight is the granting process for renewable sources. It simplifies the authorization so the generators are not necessarily required to participate in an auction. These entrepreneurs are exempt from allocating 1% of net operating revenue for investment in research and development in the sector.

In 2016, the 'PCHs' were granted exemption from paying financial compensation for the use of water resources (Law nº 13.360). This will be applied until the extension of their grants end, and will be calculated at 50% of the charge of the other hydroelectric plants and calculated as established in Law n.º 9.648, of 1998.

In the commercialization field, consumers with power equal to or greater than 500kW can negotiate directly, and contract, as a distributed generator, directly with the energy distributor. There is permission to share the transmission facilities of restricted interest, the generation central for shared connection (ICG), reducing costs of connecting to the network.

Brazil still has a long way to go in order to make better use of these renewable sources, and existing incentives should be evaluated, bottlenecks identified, durable and efficient measures proposed to promote the adequate use of available infrastructure, and meet the needs of society. The firmness of the supply to the diversification of its matrix, the transmission system, the adaptation to the environmental parameters and the tariff modicity. The biggest challenge is the lack of a more agile and adequate legislation that encourages a policy of implantation of an electrical matrix with a new profile.

The incentives granted by the electric policy are paid by the Energy Development Account (CDE), representing an additional burden for Brazilian society. In 2016, CDE's budget reserved R $ 1.2 billion to cover the discounts at TUST and TUSD. The grant of 1.5 billion in benefits represents an average increase of 1% in the final consumers' tariff. Therefore, the cost of the account is one of the challenges for the sector. The projection of 45 GW in sources encouraged for the year 2024 (Ten Year Plan) will generate an account of R $ 4 billion. The analysis of the incentives against the tariff resources should be considered.

Brazil has also implemented mechanisms to systematically purchase wind energy, providing investments and consolidating the national component and wind turbine industry. As part of a public policy to stimulate the country's production chain, the public banks that granted the financing required increasing nationalization rates. The law instituted nationalization of equipment and services of at least sixty percent.

The National Bank for Development (BNDES) created the 'Progressive Nationalization Plan' for wind turbines, which forced the industries to invest about R $ 500 million in order to meet this requirement of BNDES and its customers. The requirement of 60% nationalization generated delays at first, but encouraged manufacturers to install wind turbine production and assembly plants.

Experimenting with new technologies and production at scale have led to lower costs. Even so, the costs for consumers are still significant. The Annual Proinfa Plan for 2016 indicates that the total of 131 enterprises were benefited and received annual subsidies of $ 2.78 billion (ANEEL, 2016)

Currently, wind power accounts for about 30% of the system load in the Brazilian Northeast and arrives, in peak situations, to meet 10% of the load of the national interconnected system. In percentage terms, the share of wind energy reaches around 7% of installed capacity. With the implementation of more than 14 GW contracted in auctions, the forecast is that, in 2020, the share of wind power will be around 10% to 12%, which will correspond to the second source of energy of the national electricity matrix. Brazil ranked 15th in terms of installed capacity in 2012 and reached tenth position in 2015.

In 2015, 21.4 TWh of wind energy were generated, 11 million houses were supplied monthly with this energy, 10 million tons of $CO_2$ ceased to be emitted and about R $ 645 million were no longer spent on fuel for the thermals. We were, in 2015, the fourth most invested country in the world and the eighth country in wind power generation.

The adjacent figure shows the rapid growth of wind generation.

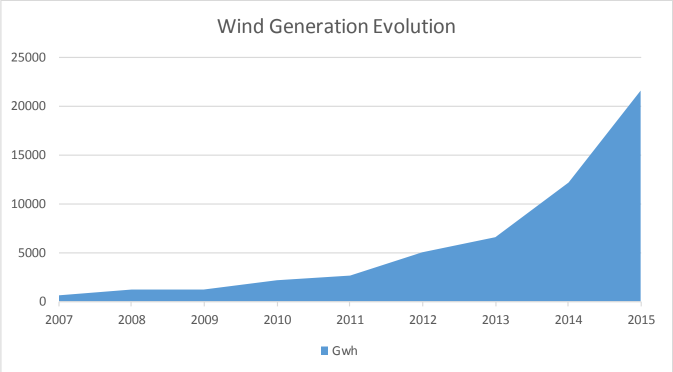


*Figure 2- Evolution of Wind generation -2007 to 2015.*
Source: BEN 2016

Biomass is important due to its predictability and stability, despite its seasonality, and should be considered because it is not intermittent. Bioelectricity has its generation carried out predominantly between April and November, the dry period of the year, and there is a possibility of generation until the off-season. Its stability facilitates the planning of its use, and the fact that there may be generation even in the off-season means that bioelectricity can compensate with the intermittent nature of other renewable sources.

The energy generated by biomass in the country's consumer center greatly reduces transportation and logistics costs. About 90% of processed cane is in the Midwest and Southeast regions, which account for 60% of the consumption load. Each ton of sugar cane produces 250kg of bagasse and 280kg of straw, and the straw has twice the calorific value of bagasse. In 2010, biomass added 1,750 MW to the grid, which is equivalent to 12% of an Itaipu. This was the result of Proinfa, regulated auctions and a policy more dedicated to this source. In 2015, sugarcane biomass generated 20,169 GWh for the grid. This meant serving more than 10 million households and reducing $CO_2$ emissions by 8.6 million tons. This type of generation saved 14% of the water in the hydroelectric reservoirs of the Southeast/Center-West sub-market.

The installed capacity of biomass plants on the National Interconnected System (SIN) reached 11.6 GW in June 2016 (CCEE, 2016). The expansion was 7.4% over the same period last year, when capacity was 10.8 GW. In the first half of 2016, biomass-based thermal plants produced 1,942 average MW, an increase of 6.1% over the average generation of 1,831 MW in the same period of 2015. The sector believes that potential could be better utilized and calls for a clearer public policy that defines the role of ethanol and biomass in the energy matrix, seeking greater use of energy cogeneration and its inclusion in auctions for reserve energy.

In percentage terms, the share of renewable energy in the electric power matrix is around 7%. (source and month) with the insertion of more than 14 GW already contracted in auctions, this percentage is expected to reach 10% to 12% by 2020. This represents the goal established in the second stage of Proinfa: 10% of the annual consumption of electricity in the country, in 20 years, that is, 2022. With these measures, renewable energy will be the second source of energy in the National power matrix.

Therefore, it is necessary to consider a long-term horizon in planning for electric power security for Brazilian society. It is, therefore, necessary to try to identify bottlenecks, and propose durable measures that, in addition to efficiently using the facilities that will be built, should consider other alternatives to remedy the problem. The security of supply is not only linked to the capacity to supply the energy, but also to its adequate transportation.

There are many challenges encountered by those who seek participation in the supply of energy to the network, from lack of information to deficiencies of regulation, and more specifically, the differences of interpretation among power distributors in the distributed generation connection process. There are some initiatives in the tax field, such as the exemption of ICMS for consumers who implant an energy system for their own consumption. However, the cost still remains high.

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